Chapter 2

The Scope of Supply Chain Management

2.1 Collaboration in Supply Chains

2.1.1 Insufficient Collaboration Results in the Bullwhip Effect

The key feature of SCM is close collaboration between two or more business partners. One of the goals aspired to is to smooth processes and to avoid unpredictable ordering behavior of the main customers; more specifically, to avoid the upstream demand amplification already studied in System Dynamics models (Forrester 1961) and popularized as the bullwhip effect (Lee et al., 1997a, b). The first company to report this phenomenon was Procter&Gamble, which it observed in its diaper supply chain. The most prominent model showing the bullwhip effect is the Beer Game (Sterman 1989). Delays in transferring order information and in fulfillment (due to lead times) and the absence of information sharing are main reasons for the bullwhip effect.

To reduce the bullwhip effect, the members of the supply chain may try to improve their information systems and/or their physical systems. Since the speed of data transfer technology has been dramatically improved in recent years, the assumptions prevalent in the Beer Game about the delays in information transfer can only stem from administrative processes in order management. Data is typically not transferred in real-time, and the coordination effort resulting from the using of different systems may also contribute to time-lags. Furthermore, if the demand is static and normally distributed, there is no reason to order distinct volumes at different time points. If the retailer ordered steadily, the other companies would not have to react nervously to unexpected order volumes. Thus, the bullwhip effect is at least partially homemade.

The main implication of studying the demand amplification is that transferring Point-of-Sales (POS) data to the other partners in the supply chain will considerably reduce the bullwhip effect. However, the question arises why a retailer should share its POS data with other members of the supply chain. One argument is that the supply chain is becoming more competitive, by realizing smoother planning, scheduling, and execution processes. The retailer may also agree to provide the POS data if it assumes that this supportive behavior will result in lower purchase prices or, at least, improve its bargaining power. Furthermore, data about capacity, capacity usage, and inventory may also be shared and be beneficial for the downstream companies. Simulation studies show that the information exchange typically is more important for upstream than for downstream companies (Chatfield et al., 2004).

With respect to collaboration, several maturity levels of supply chains have been defined:

- Stage 1: Functional Focus: Operating discrete supply chain processes with functional management of resources. Supply chain processes and data flows are well documented and understood.
- Stage 2: Internal Integration: Company-wide aligned and integrated supply chain processes continuously measured and steered to achieve common objectives.
- Stage 3: External Integration: Collaboration with strategic partners (customers, suppliers, and service providers) including joint objectives, shared plans, common processes, and performance metrics.
- Stage 4: Cross-Enterprise Collaboration: Information Technology and e-business solutions resulting in real-time planning, decision making, and execution of customer requirements (Roussel and Skov 2007).

The data recorded in the course of the survey shows that only a few companies realize collaboration beyond stage 2; thus, today collaboration between independent legal entities is not very common. However, it should be recognized that the evolution does not necessarily follow this sequence and that some stages (in particular stage 2) may be skipped.

SCM and sourcing decisions are closely related. The number of suppliers may be reduced when a supply chain is designed. In an idealistic view, single sourcing would be appropriate for parts that are offered by supply chain partners. However, risk management may contradict a single sourcing policy. Globalization has a huge impact on achieving supply chain goals. Sometimes offshoring decisions are based on rather myopic views on direct production costs, neglecting such matters as the total cost resulting in the supply chain and the impact on lead times.

2.1.2 Types of Collaboration

2.1.2.1 Information Exchange

Information access and data transfer are highly recommended in SCM systems. Information exchange is bidirectional, while information transfer may be unidirectional. As the company delivering data may not know whether the data transferred or exchanged is relevant for the recipient, the terms data exchange and data transfer would be more suitable. Transfer or exchange of data does not necessarily imply that the recipient is using this data. Therefore, data transfer does not imply that the planning processes of the supply chain partners are based on consistent data. A simplified morphological box distinguishing different types of data exchange is shown in Table 2.1.

Table 2.1 Types of data exchange

Data characteristics	Occurrences			
Source of data	Last element in supply chain (retailer, OEM)	Tier-1 supplier	Tier-2 supplier	…
Recipient of data	Next organization upstream	Next but one/two … organizations upstream	Next organization downstream	Next but one/two … organizations downstream
Category of data	Actual data	Forecast data	Planning data	Meta data
Amount of data	All data	Selected data, defined statically	Rule-based selected data	—
Granularity of data	Elementary data	Aggregated data	—	—
Type of provision	Data access (pull)	Data transfer (push)	—	—
Timeliness	Time-point	Period	—	—
Up-to-dateness	Real-time data	Delayed data, delay time-based	Delayed data, delay rule-based	Delayed data, delay resolved ad hoc

Actual data may be about (e.g.)

- sales volumes at POS,
- inventories,
- warranties,
- capacity usages,
- events, and
- compliance issues.

Planning data concern (e.g.)

- strategies,
- investments in physical systems and information systems,
- events such as promotions, announcements of end-of-life products, or of new product introduction,
- procurement,
- production,
- scheduling,
- distribution, and
- financial matters.

Meta data may be exchanged to coordinate

- quality control, and
- the use of IS, in particular the
  - customization of IS,
  - data models,
  - process models, and
  - numbering systems.

Another type of data transfer tries to improve the capabilities of the suppliers, for example with respect to product quality.

Mini case: Nestlé supports sustainability in the supply of agricultural raw materials and agricultural best practices. To translate its words into actions, Nestlé employs over 800 agronomists, technical advisers, and field technicians. Their job is to provide technical assistance to more than 400,000 farmers throughout the world to improve their production quality, as well as their output and efficiency. They do this on a daily basis in as many as 40 countries. This specialist team has pioneered the development of sustainable local fresh milk and coffee production (Nestlé 2006).

2.1.2.2 Collaborative Forecasting

Collaborative forecasting is based on data exchange or transfer, but does not necessarily result in collaborative planning. This distinction is also emphasized in the CPFR model (cf. Section 2.1.2.4). The goal of collaborative forecasting is to find a consensus on future data that may be used in local planning or in collaborative planning efforts.

The Delphi method is a well-known procedure for collaborative forecasting of future trends. Results show that divergent opinions of experts converge some way toward a consensus when those involved are informed about opinions expressed by other experts. However, the result of applying the Delphi method is not a forecast accepted by all concerned. The Delphi method is typically not used in routine forecasting of operative data but in forecasting future trends. Application of the Delphi method can be supported by specific IT systems.

Achieving a common forecast of quantitative data, for example about future demand for certain products or product groups, is a difficult task. Planning typically means considering distinct scenarios that differ in the assumptions and data underlying them. A company may look at several scenarios, and the common forecast may be just one of several considered. An agreement to use only a consensus forecast may reduce the value of local planning processes considerably and cannot be enforced.

2.1.2.3 Collaborative Planning

Collaborative Planning aims to coordinate the plans of several partners in the supply chain. The associated models can be managed by one or more of the firms involved or by a trusted service provider.

Several types of models may be used. Spreadsheet models and simulation models may be developed to show the consequences of different decisions in certain planning scenarios ("What-If Models"). How-to-Achieve Models change the perspective by stipulating target values and determining the corresponding value of an independent variable. Decision models are used to determine the best solution by optimizing algorithms or to find a satisfactory solution by applying heuristics.

Collaborative planning differs from individual planning in several ways (Table 2.2, partially based on Windischer and Grote 2003).

Table 2.2 Comparison of individual planning and collaborative planning

Individual planning	Collaborative planning
Recognizing the sequential order of events	Communication of anticipated events
Recognizing goals	Lateral agreements on goals
Recognizing the availability of alternatives	Information exchange about the availability of alternatives
Recognizing the adequacy of plan's resolving	Recognizing the adequacy of common plans
Monitoring planned actions and diagnosing errors in individual plans	Monitoring and diagnosing errors in common plans
Revising individual plans	Coordination of planning and feedback about modifications
Canceling individual plans	Common reflection and common decisions to cancel plans

Depending on the amount of information transparency agreed upon, several types of collaborative planning can be distinguished. One of them is Open Book Planning. The collaborating entities deliver data into a common planning model. The semantics of this data (i.e., the definitions used in the data models) must be carefully coordinated. The data and the results obtained by the planning procedure become visible to all participating entities. A very high level of trust is necessary between the partners for this approach to be realized. Even entities belonging to the same group may have objections against (detailed) Open Book Planning. The Open Book may be accessible only to selected members of the supply chain. However, in such a situation it may be even more difficult to make sure that the other entities deliver correct planning data.

Another approach is to install a trusted service-provider as the entity collecting data for the planning model and delivering the planning results to the supply chain partners. In this case the cooperating entities are treated equally with respect to information transparency. However, results of a planning model are usually not implemented without further consideration. The purpose of decision models is to provide insight, not numbers. Insight is based on understanding relationships between input data and output data. It may be difficult to gain insight if the effects of modifying input data cannot be discussed in detail because the input data is clandestine.

A common planning model may become complex owing to its size and the details considered, and it may be difficult to find appropriate algorithms for determining an optimal solution or even for applying a sound heuristic. Decomposition has been recommended to reduce the complexity of decision models. In this case it is not necessary to exchange all details of the data relevant to the planning model, but only some results obtained from local planning models.

Decomposed decision models are solved in an iterative way. The results of the planning model P_{ir} of entity i in iteration r are used by the collaborating entity j in iteration $r + 1$. Entity j will consider the effects of P_{ir} on its own situation and decision variables and develop plan $P_{j,\,r+1}$, which is communicated to entity i. Thus, the planning results of one entity appear as input data in the plan of the other entity.

For obvious reasons only a limited number of such organizational iterations can be realized. The optimal solution, which could be determined by an Open Book model, will typically be missed. However, numerical experiments show that even a small number of organizational iterations may result in solutions that are quite close to the optimum of the Open Book model and, from the perspective of the supply chain, far better than local solutions obtained without collaborative planning (Dudek 2004; Dudek and Stadtler 2005).

2.1.2.4 Collaborative Planning, Forecasting, and Replenishment (CPFR)

Several frameworks for structuring collaboration tasks exist. The best known is the CPFR® framework. CPFR® is a reference model developed by the Voluntary Interindustry Commerce Solutions (VICS) Association. Fig. 2.1 shows that the CPFR model distinguishes eight collaboration tasks. For collaboration between a retailer and a manufacturer the tasks are exemplified in Table 2.3.

2.1.2.5 Collaborative Scheduling

As scheduling decisions are often short term and taken close to execution, real-time information exchange and contingency management among geographically dispersed entities may be beneficial (Jia et al., 2002; Boyson et al., 2003).

The schedule of transports may determine production schedules, and a need for the exchanging of information between distribution and production schedulers results (Chen and Vairaktarakis 2005). The customer may receive information about successfully finished operations and the time intervals for which remaining operations are scheduled. This could be done via alerting mechanisms (e.g., sending e-mails or messages to a PDA), by providing information on the Web, or even by allowing access to (parts of) the partner's scheduling system.

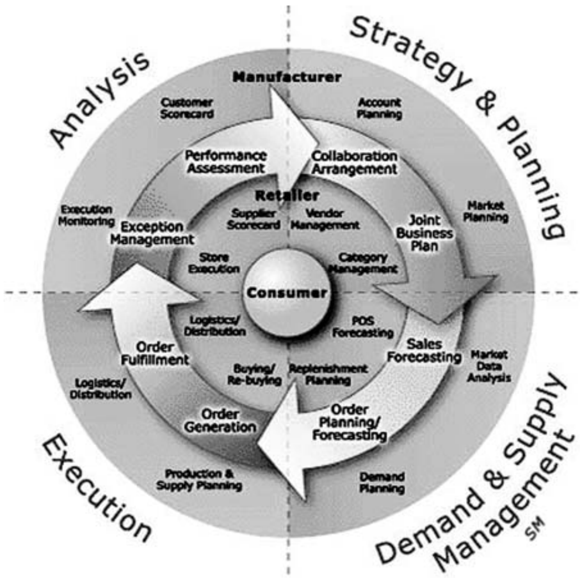

Fig. 2.1 Visualization of the CPFR® process (VICS 2004)

Table 2.3 Collaboration tasks between a retailer and a manufacturer (cf. VICS 2004)

Manufacturer Tasks	Collaboration Tasks	Retailer Tasks
	Strategy and Planning	
Account Planning	Collaboration Arrangement	Vendor Management
Market Planning	Joint Business Plan	Category Management
	Demand and Supply Management	
Market Data Analysis	Sales Forecasting	POS Forecasting
Demand Planning	Order Planning/Forecasting	Replenishment Planning
	Execution	
Production and Supply Planning	Order Generation	Buying/Re-buying
Logistics/Distribution	Order Fulfillment	Logistics/Distribution
	Analysis	
Execution Monitoring	Exception Management	Store Execution
Customer Scorecard	Performance Assessment	Supplier Scorecard

Mini case: In the chemical industry, changes in the schedule of one plant can affect several other plants, and ripple effects may increase the magnitude of changes in plants downstream. For instance, in the Bayer company the plant schedules are highly interdependent. The results of the nightly centralized scheduling run are broken-down into plant-specific models where decentralized planners use these models for local changes. The local scheduling persons should

- *be able to work on a smaller model of the facilities they are allowed to schedule but at the same time be able to share data with and view information from other plants,*
- *be able to see the schedule changes of relevant production steps in other plants,*
- *make other plants aware of schedule changes, and*
- *reduce conflicts and find a mutually agreeable solution for product chains running through multiple plants with the help of a chain planner.*

Complex communication mechanisms are set up to achieve these goals. Central coordination mechanisms are combined with complementary information exchange amongst decentralized decision makers between the scheduling runs (Berning et al., 2002).

2.1.2.6 Collaborative Execution

Collaborative execution may be closely connected with reassignment of tasks and resources and the redesign of physical processes. In this case not only information and planning systems are influenced by SCM but also the physical execution systems.

Changes of physical systems have been suggested by such production management concepts as Just-in-Time (JIT), Lean Production, and Agile Manufacturing. JIT needs close collaboration between the partners, and reducing setup times is an important precondition for the realization of JIT procedures. Cross-docking is a concept intended to minimize handling times at distribution centers by tight coordination of inbound and outbound transports. Track&Trace systems show the progress made in bridging the spatial distance between supplier and recipient and allow the recipient to prepare for arrivals, but also to adjust production schedules if an item required should arrive too late. Visibility of real-time data for business partners is regarded as one of the main properties of a "real-time enterprise." Many SCM systems support the visualization of data.

Mini case: Several companies with basically decentralized organizational structures achieved significant improvements through central coordination of material handling. For instance, the largest Swiss retail company Migros helped to develop an Application Service Providing (ASP) platform for achieving better visibility and transparency of the associated pallet flows between its suppliers, the central regional warehouses, and its supermarkets (Knolmayer and Dedopoulos 2006).

2.1.2.7 Collaborative Monitoring and Controlling

Mini case: In the 1980s, General Motors' Service Parts Operation used sophisticated Operations Research methods for inventory and transportation management in its relationships with dealers. However, the service to consumers was consistently poorer than the service of most of its competitors, because the dealers' inventory systems were out of control, resulting in outdated data and metrics and wrong stock-keeping decisions. This illustrates the fact that a supply chain is only as good as its weakest link (Hausman 2004).

Many criteria have been proposed for measuring and evaluating the performance of a company's logistical system. Examples are

- (differently defined) service levels,
- response delay, the difference between the delivery day initially requested by the customer and the negotiated day,
- lateness, computed from the differences between negotiated delivery day and actual delivery day,
- (differently defined) stocks, e.g., work in progress (WIP) as a percentage of sales,
- mean and variance of throughput times, and
- percentages of scrap in production and corrupted inventory.

The Supply Chain Operations Reference (SCOR®) model developed by the Supply-Chain Council (SCC) defines more than 200 Key Performance Metrics at the highest of four levels. SAP SCM™ provides more than 300 KPI that are based on the SCOR® metrics. Three classes of customer-facing and two classes of internally oriented performance attributes are distinguished (cf. Supply Chain Process Improvement 2007):

- Customer-facing performance attributes
  - Reliability
    - Delivery performance
    - Perfect order fulfillment
    - Fill rates
  - Responsiveness (Order fulfillment lead times)
  - Flexibility
    - Supply chain response time
    - Production flexibility
- Internal-facing
  - Costs
    - Costs of goods sold
    - Total SCM costs
    - Warranty/returns processing costs
  - Asset management efficiency
    - Cash-to-Cash cycle time
    - Asset turn.

The Supply Chain Performance Indicator, which has been defined by The Performance Measurement Group (2007), considers a broad spectrum of business-related metrics which shows the high impact of good SCM practices on business results. With respect to the large number of metrics it is recommended that the most relevant ones be selected. These may be visualized on a dashboard, using Kiviat graphs, spider diagrams, or Balanced Scorecards (Kaplan and Norton 1996).

In addition to the SCOR® model, a Design Chain Operations Reference (DCOR) and a Customer Chain Operations Reference (CCOR) model have been defined by the SCC. These models also define many metrics. A projection of some metrics to Balanced Scorecard Categories is suggested by Bolstorff (2006). Ways of projecting the SCM metrics into terms of income statements, balance sheets, and Economic Value Added indicators have also been suggested (Camerinelli and Cantu´ 2006).

For supply chains, two different controlling approaches exist. On the one hand, each entity in the supply chain can define its own criteria and eventually present the values achieved in a Balanced Scorecard; however, if this information is passed on to partners, a shared meaning should be accomplished, and this can only be reached when there is agreement upon the definition of data elements and co-ordinated procedures are applied. On the other hand, common metrics for the whole supply chain may be defined and eventually presented in a Supply Chain Scorecard; coordination of meta data becomes even more relevant when this approach is followed (cf. Ackermann 2003; Kleijnen and Smits 2003).

2.1.2.8 Collaborative Reassignment of Tasks

The most far-reaching type of collaboration is a coordinated restructuring of functions and processes, which may result in reassignment of task responsibilities from one supply chain partner to another. In redesigning a supply chain, inter-mediation or disintermediation may be considered when tasks are reallocated; one example of such an approach is the Fourth-party Logistics Provider (4PL) concept. Quality control can be moved from the customer to the supplier after a common quality management system has been agreed on. Financial flows can be reorganized by applying Electronic Bill Presentment and Payment (EBPP) systems (SAP 2001) as part of Financial Supply Chain Management.

Vendor Managed Inventory (VMI) is probably the most common reassignment of responsibilities. The customer is no longer placing orders and, therefore, no due dates for delivery are fixed. The vendor is responsible for providing concerted inventory service levels. SAP recommends considering VMI if

- key customers constitute a high percentage of the vendor's sales figures,
- the products are standardized and requested repeatedly,
- product growth is not excessive, meaning that the requirement patterns are stable and the vendor can assume that requirements will not occur spontaneously, and
- the transaction costs for order processing and production planning are high (SAP 2007).

Intentia (2001), a former vendor of ERP systems, describes benefits of VMI as follows:

- Supplier benefits
  - Visibility of the customer's POS data simplifies forecasting.
  - Promotions can be more easily incorporated into the inventory plan.
  - Customer ordering errors, which in the past would often lead to a return, are reduced.
  - Stock level visibility helps identify priorities (replenish stock versus a stockout).
  - The supplier can see the potential need for an item before the item is ordered.
- Customer benefits
  - Fill rates from the supplier, and to the end consumer, improve.
  - Stockouts and inventory levels often decrease.
  - Planning and ordering costs decrease since the responsibility is shifted to the supplier.
  - The overall service level is improved by having the right product at the right time.
  - The supplier is more focused than ever on providing superior service.
- Dual benefits
  - Data entry errors are reduced owing to computer-to-computer communications.
  - Overall processing speed is improved.
  - Both parties strive to offer better service to the end consumer. All parties involved benefit when the correct item is in stock when the end consumer needs it.
  - A true collaborative partnership is formed between the supplier and the customer.

Extremely high benefits are reported from realizing VMI relationships. SAP claims very optimistic figures that have been reported by SAP customers or independent third-parties (Table 2.4, cf. SAP 2007).

Mini case: Knorr-Bremse, a leading producer of brake systems with more than 60 locations in 25 countries, implemented the SAP Inventory Collaboration Hub™ in 2005. The costs of order processes and administration expense were reduced by more than 50%. Many A and B materials are stored via Supplier Managed Inventory agreements. Capital lock-up was reduced by lower warehouse inventory and safety stocks (Brauchle 2006).

Table 2.4 Potential benefits of VMI (SAP 2007)

Business benefits	Vendor/customer	Value potential
Increased revenue/sales	Vendor and customer	100–200%
Lower inventory levels	Vendor	70%
Increased service levels	Vendor	From 89% to 98%
Operating costs through full truckloads	Vendor	28%
Increased service levels	Customer	From 93% to 99%
Inventory turns	Customer	27–70%
Increased service levels	Customer	From 93% to 99%

When considering the potential of VMI one has to realize that it is based on the transfer of detailed data, e.g., POS data and inventory data. Such data transfer may be realized with or without entering on a VMI relationship. An advantage of VMI is that no due dates are fixed by the customer, which makes the vendor flexible with respect to its execution processes. However, the vendor may lack some information which is available only locally at the site of its customer. VMI partnerships should incorporate the obligation to transfer either such local information or at least forecast data based on it. Several simulation studies on VMI systems show significant cost reductions for the entire supply chain (Disney and Towill 2003a, b). As suppliers have access to actual sales and/or inventory data provided by the customers, the Bullwhip Effect can be reduced, resulting in a smaller variability of demand data (Småros et al., 2003). Thus, safety stocks, particularly of suppliers, can be reduced.

Sometimes a distinction is made between Vendor Managed Inventory and Supplier Managed Inventory (SMI). In the CPFR® context four alternatives are distinguished (Table 2.5). The difference between VMI and SMI is primarily one of viewpoint: VMI involves the management of finished goods inventories outbound from a manufacturer, distributor, or reseller to a retailer, whereas SMI manages the flow of raw materials and component parts inbound to a manufacturing process (Pohlen and Goldsby 2003). IT ownership and IT architectures differ. In the SAP environment there is also a difference in the ownership of the collaborative application system – for VMI the application system is owned by the supplier and for SMI, by the customer.

Table 2.5 Assignment of responsibilities (cf. VICS 2004)

Alternative	Sales forecasting	Order planning	Order generation
Conventional approach	Retailer	Retailer	Retailer
Co-managed inventory	Retailer	Retailer	Manufacturer
Supplier managed inventory	Retailer	Manufacturer	Manufacturer
Vendor managed inventory	Manufacturer	Manufacturer	Manufacturer

2.2 Business Architectures for Supply Chain Management

2.2.1 *Supply Chain Planning Matrices*

Several models have been followed to arrange the most relevant SCM processes in systematic frameworks. In the research literature several (slightly different versions of) Supply Chain Planning Matrices (Fig. 2.2) are presented (cf. Neumann et al., 2002; Fleischmann and Meyr 2003; Fleischmann et al., 2005; Meyr et al., 2005).

A detailed description of the matrix is given by Fleischmann et al. (2005, p. 88). In our opinion, Supply Chain Planning Matrices have some disadvantages. The arrows in the top row imply that a certain flow occurs independently of the type of production system. However, for make-to-order production the sequence of the columns "Production," "Sales," and "Distribution" should be "Sales," "Production," and "Distribution," and order-specific design activities for make-to-engineer production should appear. Furthermore, the execution and controlling processes are disregarded in the framework and the collaboration with other companies is not visualized in the matrix. We try to improve these shortcomings in our pyramidal representation (cf. Section 2.2.3).

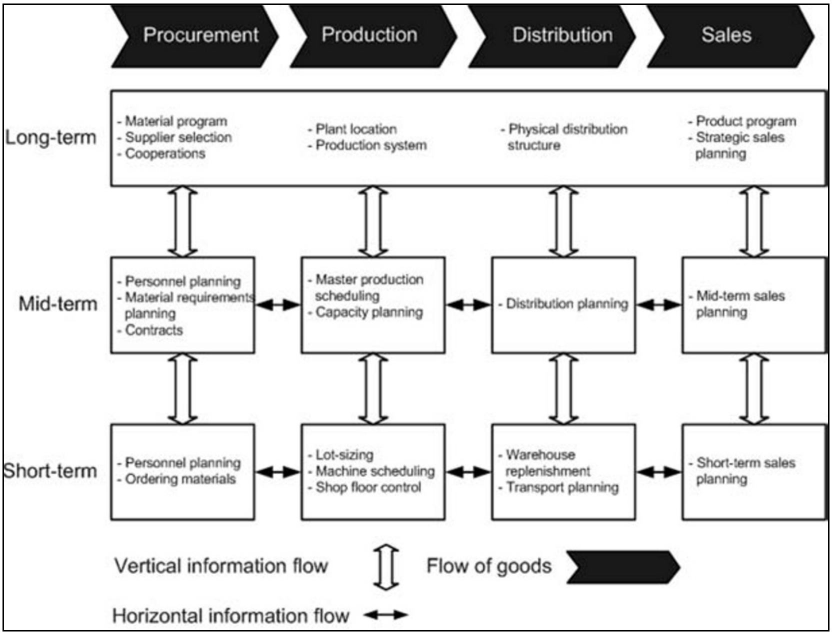

Fig. 2.2 A supply chain planning matrix

2.2.2 The Supply Chain Operations Reference Model

In practice, the Supply Chain Operations Reference (SCOR®) Model developed by the Supply-Chain Council is attracting a lot of attention. Today the Council counts about 1,000 corporate members worldwide and has established chapters in North America, Europe, Greater China, Japan, Australia/New Zealand, South East Asia, Brazil, and Southern Africa. In 2008, Release 9.0 of the SCOR® model was made public (Supply-Chain Council 2008). SAP AG is a member of the SCC and a main sponsor of its activities.

The SCOR® model is a process reference model, proposing a certain terminology and system of notation for describing business processes. It is organized into four levels to allow differently detailed views on business processes and focuses on inter-organizational processes. A company or a supply chain may use the SCOR® model to describe the current status of the system ("as-is" situation) or to define a target status ("to-be" situation). Such models are often used in business process reengineering projects. The SCOR® model also defines metrics used to measure the performance of certain process elements. A company may decide to gather this data for internal performance evaluation or also for benchmarking with other companies. The SCC tries to motivate its members to deliver performance data for the SCOR® metrics to support inter-organizational benchmarking and to recognize "best practices."

The SCOR® model defines five process types

- Plan
- Source
- Make
- Deliver
- Return

at four hierarchical levels. At the uppermost level, the process types are defined as shown in Table 2.6. According to the SCC, level 1 of the SCOR® model aims to support companies in making basic strategic decisions regarding its operations in the following, sometimes vaguely formulated areas:

1. Delivery performance,
2. Order fulfillment performance,
3. Fill rate (make-to-stock),
4. Order fulfillment lead time,
5. Perfect order fulfillment,
6. Supply chain response time,
7. Production flexibility,
8. Total SCM cost,
9. Value-added productivity,
10. Warranty cost or returns processing cost,

11. Cash-to-cash cycle time,
12. Inventory days of supply, and
13. Asset turns.

At level 2, e.g., the Make process is refined to

- Make-to-stock production,
- Make-to-order production, and
- Make-to-engineer production,

whereas the Return process is detailed to

- Return defective product,
- Return Maintenance, Repair, and Overhaul (MRO) product, and
- Return excess product.

Level 2 also defines some enabling processes. A typical example of an enabling process is to provide the necessary IT infrastructure for process execution.

In 2007, the SCC announced SCORmark℠, a members-only benchmarking portal based on the SCOR® model, in association with APQC (Supply-Chain Council 2007). As part of the "analyze" phase of the SCOR® model, a company may use SCORmark℠ benchmarking

- to select the supply chain metrics most critical to its organization,
- to determine the target performance desired for each supply chain attribute in the SCOR® model, and
- to enter the relevant data required to calculate the performance for each selected metric into the secure, confidential benchmarking portal.

Table 2.6 Level 1 Processes, as defined by the Supply-Chain Council

SCOR® process	Definition
Plan	Processes that balance aggregate demand and supply to develop a course of action which best meets sourcing, production, and delivery requirements.
Source	Processes that procure goods and services to meet planned or actual demand.
Make	Processes that transform products to a finished state to meet planned or actual demand.
Deliver	Processes that provide finished goods and services to meet planned or actual demand, typically including order management, transportation management, and distribution management.
Return	Processes associated with returning or receiving returned products for any reason. These processes extend into post-delivery customer support.

The data is validated in a seven-step process to produce a report with

- an executive scorecard to quickly spotlight on any gaps in the targeted performance levels for each supply chain attribute and
- a detailed analysis for each specific metric selected, including best practice information on the drivers of performance and peer group reporting as available.

ARIS™ is a business process management tool developed by IDS Scheer and today offered as part of SAP's NetWeaver infrastructure. Among other tools, an ARIS EasySCOR Modeler has been developed (IDS Scheer 2007).

Software vendors included SCOR® metrics in their SCM systems (Gassmann 2001). The SAP Solution Manager is an implementation tool that allows mapping of the SCOR® model's "best practices" against what the users want in their SAP ERP™ and SAP SCM™ implementations. Once in operation, the SAP ERP™ and SAP SCM™ systems automatically deposit the data from ERP and ongoing supply chain transactions into SAP's Business Intelligence™ applications. These calculate the plan-source-make-deliver KPIs and deliver them to SAP's management cockpit for role-based breakdowns of the SCOR® model (Gould 2005).

Some deficiencies of the SCOR® model as seen from an academic point of view are discussed by Huan et al. (2004) and Poluha (2007).

2.2.3 A Supply Chain Pyramid

Based on the Supply Chain Matrices and the SCOR® model, we present a global view of the supply chain tasks in the form of a pyramid (Fig. 2.3) and use this pyramid as a reference framework. With the pyramidal form we reflect the hierarchy of decision rights, planning tasks, and the associated information needs (as often visualized in "information pyramids"; cf. Mertens 2007, p. 6). A slightly similar "task reference model of transcorporate logistics" in pyramidal form was proposed by Hieber (2002).

Fig. 2.3 shows inbound- and outbound-collaboration tasks at various organizational levels. Strategic, tactical, and operational planning tasks are distinguished at the horizontal levels. For ease of presentation, operational planning and scheduling are combined at one level. Source and procurement and make and production are used synonymously. Execution is explicitly included in the pyramid.

Compared with the SCOR® model, product design is enclosed in the pyramid to avoid the formulation of a separate design model. Furthermore, the SCOR® model does not explicity address sales activities (which later became part of the widely neglected CCOR). To emphasize the high importance of selling, we decided to split the

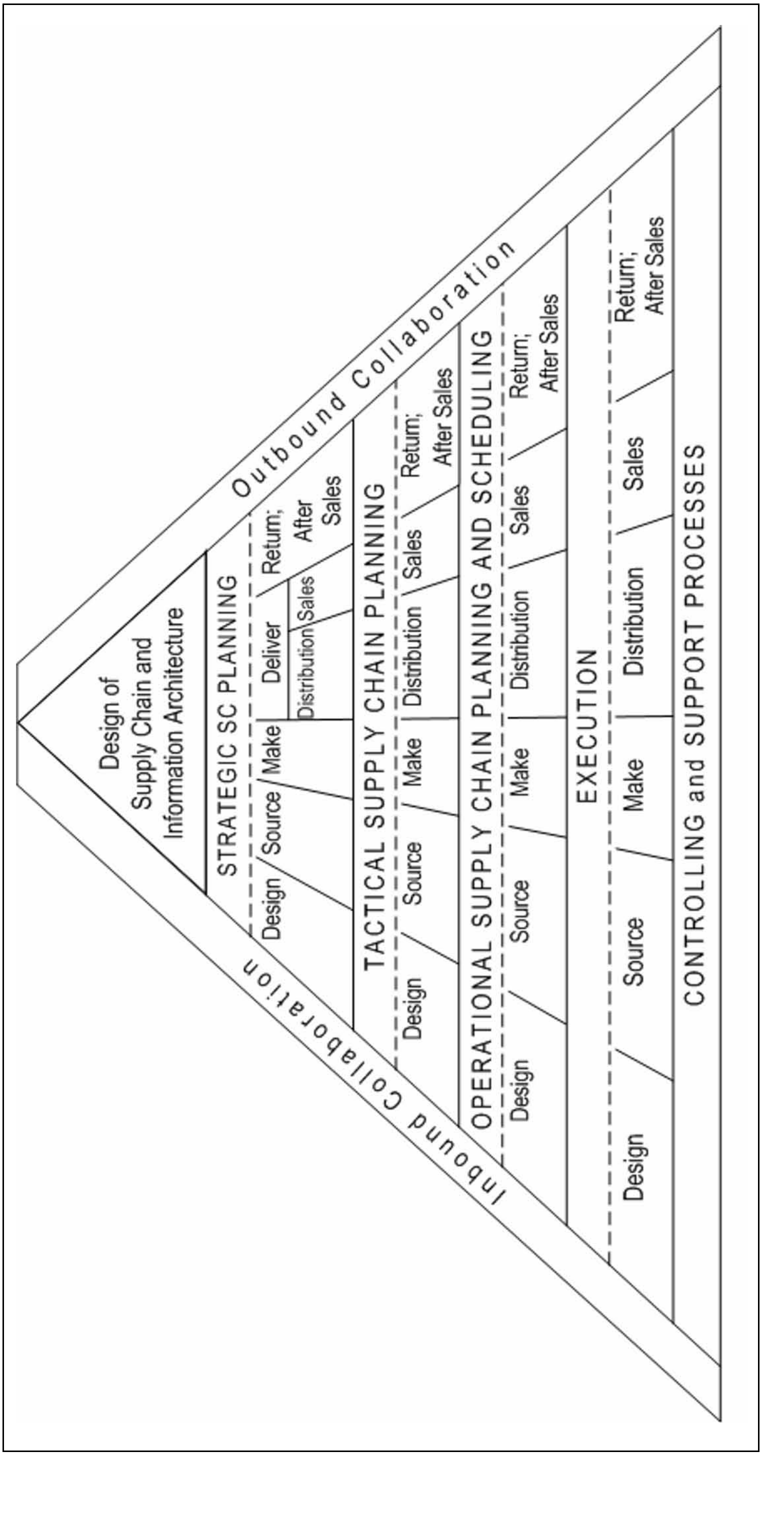

Fig. 2.3 Pyramidal reference framework for Supply Chain Management

delivery process into distribution and sales already in our Supply Chain Pyramid. We avoid arrows to indicate that sequences between sales and distribution activities depend on the type of business relationships. Finally, we think that regular after-sales processes are at least as important as return processes and therefore decided to mention them explicitly in the SCM pyramid. These modifications are in line with the Supply Chain Visibility Model proposed by the IBM Institute of Business Value (Butner 2007).

The pyramid is refined stepwise in the remainder of the book. First, SAP's SCM solution map is projected onto the SCM pyramid (Fig. 3.4). As we shall see, tactical and operational planning are well covered by the SAP system, as well as controlling and support processes. Some strategic planning tasks are difficult to support by means of IT systems, and there are some uncovered spots on the landscape. Product design activities are outside the scope of SAP's systems, but there are interfaces to the most relevant CAD systems.

In Section 2.3 we formulate desirable properties of SCM systems. In Chapters 3 and 4 we discuss how these properties are covered by the SAP SCM™ 5.0 system.

2.3 Desirable Features of SCM Systems

This section gives a short description of some functionalities that could be helpful for SCM. We do not describe functions that are also essential for enterprises not involved in supply chains.

Functions and processes in SCM systems have specific characteristics because

- data of several networked enterprises, not only those of one company, must be stored. There is a need for special filtering and compression mechanisms before data is fed into common databases, to avoid too great an increase in the sizes of databases and data warehouses;
- single bodies of data often have to be aggregated into larger groups: for instance, equipment into capacity groups, product characteristics into characteristics groups, products into product groups;
- bigger problems have to be decomposed before they can be treated with optimization algorithms or heuristics; examples are the segmentation of a long planning horizon into several shorter time segments, for which solutions may successively be found although typically the global optimum will be missed.

2.3.1 Design of Supply Chain and Information Architecture

	Desirable Features	Comments	Coverage by SAP SCM™
a)	Visualization of the complete supply chain/network at several levels of detail.	Powerful tools for visualization and navigation (cockpit, leitstand) are required.	Cf. Section 4.6.2.A.
b)	Modifications of the network, e.g., regarding intermediation and disintermediation or new allocation of tasks to the collaborating firms.	When structuring a supply chain, decisions have to be made about which tasks should be carried out by the supply chain partners themselves and which are to be outsourced. With the impact of the Web on the firms' cooperation, new intermediaries (e.g., Trust Centers to support financial transactions) are founded, whereas some traditional intermediaries (e.g., travel agencies) are declining in importance.	For master data relevant for modeling a given supply network see Section 4.7.3. SAP SCM™ does not provide functionality for decision support in supply network design.
c)	Configurator to formulate agreements and contracts by combining text modules (e.g., subcontracting, service level agreements, periods of notice, allowance of delays, responsibility for consignment stocks).	When the structure of the supply chain remains fixed for a longer time span during which some partners are replaced, the contracts with new partners can be derived from standardized agreements by modifying certain parameters. Examples are contracts between suppliers of standardized products and big retailers.	Not in scope of SAP SCM™.
d)	Collaborative investment planning; negotiation of investment proportions.	In supply chains the partners sometimes agree to share large investments, such as warehouses near airports or projects to improve data quality, by using RFID techniques.	Not in scope of SAP SCM™.

Desirable Features	Comments	Coverage by SAP SCM™
e) Decisions and actions to avoid multiple quality checks.	Multiple quality checks (at the supplier's site before shipping and at the customer's site after receipt) can be avoided if the partners agree on a Quality Management system: Results of quality control measures may be exchanged via a portal where the customer can see them or have them analyzed by an automated system.	Not in scope of SAP SCM™.
f) Navigation details of the master files by activating nodes and arcs such as information on capacity and costs of factories, warehouses, transportation routes, production programs of suppliers, time zones, and holidays at the locations of partners.	Top-down navigation, opening windows, e.g., to visualize such additional information as capacity constraints of suppliers or customs regulations.	Not in scope of SAP SCM™.
g) Management of variants, especially in the context of multiple sourcing.	The decision on how many and what kinds of variants are allowed is difficult because of the impact on sales and the costs of production, inventory, logistics, training, after-sales service, and capital requirements. ABC analyses are recommended for support of variants management. When parts are procured from different suppliers, these parts may not be strictly identical. This may be one reason for variants.	Not in scope of SAP SCM™.

Desirable Features	Comments	Coverage by SAP SCM™
h) Demonstrating the differences between objects [products, product features ("product interchangeability"), production processes] that can be substituted by each other and explaining the implications, e.g., additional costs caused by a substitution.	Substitution processes may be induced by changes in the cost of objects or result from sourcing or production bottlenecks.	Substitution is considered in planning; cf. Sections 4.4.6 and 4.7.3.
i) Positioning of inventory.	Decisions about storage locations of raw materials, components, and products are fundamental in SCM. Criteria include customer demand, service level agreements, transportation time and costs of transportation between sites, value of the parts, the necessary storage space (depending on the volume per item), and special technical conditions, such as cooling or security.	Decisions on whether or not to stock an existing warehouse cf. Section 4.4.2.A. Further analyses are not in scope of SAP SCM™.
j) Agreements on lot sizes and production cycles.	Set-up times and set-up costs may differ considerably between supply chain partners. The situation where one partner produces big lots a few times per year while the downstream partner manufactures small lots more often should be avoided, because such uncoordinated decisions result in avoidable inventories.	Not in scope of SAP SCM™.
k) Management of hierarchies of the sources, including service stations.	*Example: Supplier -> central warehouse -> regional warehouse -> service stations.*	Maintenance as master data; cf. Section 4.7.3. Decision support for supply chain design is not in scope of SAP SCM™.

Desirable Features	Comments	Coverage by SAP SCM™
l) Coordination of data models in databases, data warehouses, and data marts of supply chain partners.	Harmonized data models help to avoid errors in production and comparison of management information, e.g., values of KPI.	Not in scope of SAP SCM™.
m) Coordination of process and workflow models.	Coordinated workflow models avoid redundancies, support temporal coordination, and increase transparency in the supply chain.	Alerts can be exchanged; cf. Section 4.6.2.
n) Coordination of customizing parameters.	Determining the parameters of ERP systems and other software packages is a difficult task because of many complicated effects, side effects, and interdependencies. *Example: Minor modifications of the parameters of the function "consumption of plans" for final products may have far-reaching effects on stocks of components and raw materials.*	Not in scope of SAP SCM™.
o) Manifold simulations to evaluate alternatives.	Simulations could support tasks mentioned in items g), i), j), and k) in particular.	Cf. Section 4.2.

2.3.2 Collaborative Product Design (“Design for SCM”)

	Desirable Features	Comments	Coverage by SAP SCM™
a)	Cooperation of the supply chain partners in product design, value analysis, and value engineering.	An SCM-oriented design considers the effect of design decisions on all partners in the supply chain. These effects may not be obvious to the designers of a certain company; therefore, collaboration between design and manufacturing experts of the participating companies will facilitate a “Design for SCM.” During the design process several partners should be able to see the actual design results on their screens and to add hints and suggestions. The evaluation of alternative designs by the partners in the supply chain will often differ. Tools, e.g., groupware, for better coordination between supply chain partners may be helpful.	Not in scope of SAP SCM™.
b)	Process planning taking the effects on SCM into account.	Examples are the implementation of postponement concepts or requirements of RFID, such as avoiding the interruption of RFID communication by metallic packing or special protection needs of products (e.g., avoidance of damage through sharp profiles during transport).	Not in scope of SAP SCM™.
c)	Measures to allow simple transfer and exchange of product-defining data by coordinated application of CAD, PDM, and PLM systems.	If incompatible CAD tools are used, some physical components may not fit together. *Example: Delays in the development of the Airbus Superjumbo A380 are attributed to the use of different releases of the CAD system CATIA. Interoperability problems resulted from using version 4 in German and Spanish plants whereas factories in France and the UK used version 5 (Steinke 2006).*	Not in scope of SAP SCM™.

Desirable Features	Comments	Coverage by SAP SCM™
d) Manifold simulations to evaluate product and process alternatives.	Modern CAD systems allow the evaluation of some properties of physical products and processes without the necessity for building a physical prototype. *Example: A subassembly designed by the supplier has to be adjusted to suit the tools available in the assembly line of the customer's plant.*	Not in scope of SAP SCM™.

2.3.3 Sales and Demand Planning

2.3.3.1 Strategic and Tactical Demand Planning

Desirable Features	Comments	Coverage by SAP SCM™
a) Portals for collaborative planning (planning book).	The planning book is the main screen where the common data is displayed, entered, and processed and where interactive planning takes place.	Cf. Section 4.2.3.A.
b) Methods of calculating customer lifetime values.	Estimating the customer lifetime value helps in decisions on whether a customer should be invited to become member of a supply chain.	Not in scope of SAP SCM™.
c) Consideration of the product life cycle.	The life cycle profiles have to be adapted to take account of recent developments. The partners should provide relevant data for determining typical profiles for SCM purposes by using statistical methods, e.g., forecasting methods based on market saturation and sales data aggregated over the lifetime of the product.	Cf. Sections 4.2.1 and 4.4.1.C.

Desirable Features	Comments	Coverage by SAP SCM™
d) Coordinated inventory planning for products near to the end of their life cycle.	The exchange of product life cycle data is of utmost importance when it comes to inventory management of products that will soon be eliminated from the sales program. Careful coordination helps to keep the right inventory in the right warehouses, shops, and service stations.	Not in scope of SAP SCM™.
e) Supporting Collaborative Planning, Forecasting, and Replenishment (CPFR).	CPFR is a thorough coordination of functions and processes in the supply chain with potential for considerable benefits to the partners. *Example: Volvo, a Swedish car manufacturer, implemented collaborative processes with over 350 domestic and overseas vendors and suppliers. One of the main functions is the collaborative exchange of forecasts.*	Cf. Section 4.2.3.
f) Methods of VMI or SMI.	The supplier controls the inventory of the customer and replenishes it when necessary. *Example: Woolworth calls up the sales of all items in each of its branches every day after closing time.* *L'Oréal, the global market leader in the cosmetics industry, determines delivery quantities and creates an optimal delivery plan using the SAP SCM™ supply network planning capabilities based on forecast demand, anticipated stock movements, open orders, and inventory information.*	Cf. Sections 4.2.3.B, 4.3.1.D, and 4.3.2.

Desirable Features	Comments	Coverage by SAP SCM™
g) Collaborative forecasting supported by a method bank with forecasting algorithms and systems to support the selection of methods, parameter configuration, and the interpretation of results.	The partners may use different forecasting procedures, which, moreover, may be modified depending on deviations between forecast, demand, and sales. If collaborative forecasting is practiced within the supply chain, the partners should be able to analyze the details, including the parameter selections and the results, by using an explanation component.	Cf. Section 4.2.1.A.
h) Administration of time series and time series patterns, such as sales after promotions, e.g., separated for customer types and regions ("global forecasting profiles") or patterns of cannibalization.	Often promotions are limited to a region, e.g., dependent on the local weather or local holidays. Promoted products may cannibalize others. The demand may be shifted to later periods because customers build up stocks of the promoted parts and buy less in the following periods. For this reason logistic managers do not favor promotions, but the arguments of the marketing specialists often dominate, so that the problems have to be solved by SCM.	Administration of time series is a basic capability of Demand Planning and Forecasting; cf. Sections 4.2.1 and 4.4.1. Promotion planning is discussed in Sections 4.2.1.D and 4.3.2.C.
i) Incorporating external data.	Data from external databases, e.g., business cycle indicators, should be merged with internal data if this might improve the accuracy of the forecasts.	Incorporation of external data is a basic concept of SAP SCM™ via SAP BI™. Application of external data for forecasting is described in Section 4.2.1.A.
j) Standardized analyses of the accuracy of the forecasts and of the replenishment policy (Forecasting and replenishment analytics).	Common parameters of the analysis methods allow for better diagnosis of appropriate inventory levels in the partner companies.	No standard reports. For stocking decisions cf. Section 4.4.2.A.

Desirable Features	Comments	Coverage by SAP SCM™
k) Variable aggregation of resources such as workers (described by skill codes), materials, production facilities, and transport vehicles. Aggregation of periods, regions, products and product characteristics ("characteristic-dependent forecasting"), aggregation to virtual products ("phantoms"), block planning with buckets. Disaggregation of aggregate planning data, e.g., of total production quantities to countries and factories.	The systems should be able to avoid information overload by providing powerful aggregation procedures. Supply chain partners use different methods and parameters to aggregate, e.g., in order to determine data about product groups with an adequate statistical basis. In different countries the product characteristics with most impact on the market may vary. *Example: It should be possible to cluster all car motors with defined values of the* CO_2 *output or all toys made from the same raw material.*	Cf. Sections 4.2.1, 4.2.2.C (regarding time), and 4.2.2.N (regarding resources).
l) Forecast after constraints.	If forecasts indicate a significant growth in demand, information on serious capacity constraints should prevent planning with these sales forecasts.	Cf. Section 4.2.1.J.
m) Collaborative demand planning.	The partners in the supply chain should try to develop common scenarios and to achieve a common estimate of the demand resulting in use of these scenarios as the basis of subsequent planning.	Cf. Section 4.2.3.A.
n) Product mix planning.	Suppliers often have an interest in receiving orders not only for single products but for product mixes. *Example: A chemical company is interested in selling product A together with product A', which emerges as a joint product in the production process.*	Cf. Section 4.7.3.

Desirable Features	Comments	Coverage by SAP SCM™
o) Collaborative delivery schedules.	Information exchange before confirmation of shipment dates can increase the probability of shipping in time.	Cf. Sections 4.2.3.C and 4.2.3.D.
p) Collaborative promotion planning.	Promotions may be triggered by inventory management (high inventory levels have to be reduced, additional warehouse space is needed), from special sales opportunities (e.g., TV and video sets before big sporting events), from finance (need to improve liquidity), or by product life cycle management (new models will soon replace old ones). Several partners may be involved, e.g., suppliers of service parts. If promotion planning is not sufficiently coordinated, peaks in demand may result and raw materials, components, or facilities may cause bottlenecks. Suppliers try to avoid a situation where several customers start promotions at the same time for the same product groups.	Cf. Sections 4.2.3.A and 4.3.2.C.

Desirable Features	Comments	Coverage by SAP SCM™
q) Variable set-up of parameters distinguishing between forecast-consumption and plan-consumption.	When an order arrives it is necessary to judge whether it is the realization of a planned order or not. If in the first case the order entry date differs from the planned arrival date, it has to be decided whether the incoming order is a realization of the earlier or the later planned order. If the incoming order is allocated to the later one, the system regards the order planned for a past period as an error, assumes decreasing demand, and therefore reduces the new forecast. If the order is classified as unplanned, this can be a trigger to increase forecasts and/or demand plans. This decision may be automated by a set of rules. In an SCM relationship this decision can be supported by information exchange between customers and supplier in a more systematic and efficient way than in other business relationships.	Cf. Section 4.2.1.F.
r) Definition of rules for the level of safety stocks (e.g. in distribution centers) and capacities.	The situation where partners hold too high or too low inventory levels should be avoided, because the chance to optimize the total inventory in the supply chain would be reduced if they did. *Example: If the partners know that they can access stocks of other partners if necessary they do not need to keep high safety stocks of their own.* *In a case study inventory positioning was identified as the by far most important driver for improving supply chain metrics (Simchi-Levi et al., 2008).*	For internal collaboration cf. Sections 4.2.2.A and 4.4.2.B. Collaboration with external partners regarding safety stock levels is not covered by SAP SCM™.

Desirable Features	Comments	Coverage by SAP SCM™
s) Backorder processing with different options.	If backorders occur, the confirmation of customer orders may be temporarily revoked for planning purposes. The option selected will influence the deployment process and affect which orders are fulfilled in-time.	Cf. Section 4.2.5.G.
t) Formulation of rules for allocating scarce products to distribution centers and warehouses in case of shortages (Deployment).	The system should support consistent behavior by providing deployment rules.	For details of deployment rules implemented in SAP SCM™ see Sections 4.2.2.I and 4.4.4.A.
u) Manifold simulations to evaluate alternative procedures.	To be considered: retrospective forecasts together with alternative set-ups of the parameters of the forecasting systems and of forecast-consumption methods [see items g) and q) above], for the safety stocks [see item r)], and for deployment [see item t)].	Cf. Section 4.2.

2.3.3.2 Operational Sales and Demand Planning

Desirable Features	Comments	Coverage by SAP SCM™
a) Methods for ATP (Available-to-Promise) and CTP (Capable-to-Promise).	With the ATP procedure the system checks whether a date and a quantity specified by a customer can be confirmed by the supplier. Only inventory and planned shipments are considered. CTP (Capable-to-Promise) assumes that the customer asks which quantity can be supplied at which date. If the customer accepts, CTP generates a new order (procurement, production, and/or transportation) to cover the new demand. Capacity and time constraints are taken into account.	Cf. Section 4.2.5.
b) Query of stocks and production orders across the borders of a firm, of capacities of the suppliers of raw material, parts and (transportation) services both in ATP and in CTP checks. Consideration of the results with respect to own operations. Include statistical values for scrap. Priority rules to choose from alternative actions when problems with customers' requests arise. Evaluation of alternative solutions (e.g., stock transfer by cargo flight versus sale of more expensive products at a reduced price).	Sometimes there are problems even within a big enterprise with decentralized stock keeping in determining where products and components are available. This may be caused by incompatible IT systems. The problem is even harder to solve in supply networks in which external partners are involved. One way out is to have common portals where the local systems can see which and how many items are available in different locations.	Only within the corporate group; cf. Section 4.2.5.B.

Desirable Features	Comments	Coverage by SAP SCM™
c) Links between final products and materials with their substitutes, together with information about potential advantages and disadvantages of a substitution.	Information about well-suited substitutes is especially difficult to obtain in internationally organized supply chains, since product features concerning quality, colors, durability, prize, etc. may be differently evaluated in different countries.	Cf. Section 4.4.6.
d) Classification of customers and orders; connecting the classes with priorities for order acceptance and execution.	Support of decision making in resource conflicts.	For backorder processing cf. Section 4.2.5.G.
e) Priorities for the use of scarce production resources such as machine tools.	Precondition: Alternative bills of materials and routings have been documented in the master data.	Cf. Sections 4.2.2.D, 4.2.2.E, 4.2.2.F, and 4.2.4.D.
f) Selection of regional, national, and global transportation facilities.	Trade-off between cost, time, and environmental impact of transportation options.	Cf. Section 4.2.6.A.
g) Consideration of pick-up windows.	Pick-up windows determine when customers or carriers are allowed to pick up products at the suppliers' site. They are an important restriction for transportation planning.	Cf. Section 4.2.6.
h) Using geo data to localize transports and to forecast arrival times.	May be based on RFID techniques.	Geo data is used to calculate transportation durations; cf. Section 4.2.6.A.
i) Manifold simulations to evaluate alternative procedures.	Simulations may help to analyze the effects of alternative priority rules; see items b) and e) above.	Cf. Section 4.2 (but not in combination with backorder processing as described in Section 4.2.5.G).

2.3.4 Procurement Planning

2.3.4.1 Strategic Procurement Planning

Desirable Features	Comments	Coverage by SAP SCM™
a) Make-or-buy decisions.	Portfolio models and Linear Programming models may be used to determine the consequences of different extents of vertical integration.	Not in scope of SAP SCM™.
b) Decisions between centralized and decentralized procurement.	Desktop purchasing systems may provide transparency even if MRO parts are ordered decentrally.	Not in scope of SAP SCM™.
c) Decisions between single sourcing and multiple sourcing of certain parts.	Effects of competition, risks of unavailability, and the advantages of close cooperation with preferred suppliers have to be considered.	Not in scope of SAP SCM™.
d) Methods to evaluate suppliers of products and services.	These methods may help in selection of partners for a long-time collaboration in supply chains and thus in structuring the network. Evaluating the technological and financial position of the suppliers may be as relevant as statistical data on past performance. Multiple-criteria decision-making procedures may be used to study the trade-offs between different procurement goals.	Not in scope of SAP SCM™.
e) Contract management.	Archiving contracts and defining alert mechanisms when contracts may be prolonged, cancelled, or modified.	Not in scope of SAP SCM™.

2.3.4.2 Tactical Procurement Planning

Desirable Features	Comments	Coverage by SAP SCM™
a) Directory of sources.	Global directories of sources for raw materials, parts, products, and services are needed when suppliers have to be replaced rapidly.	Not in scope of SAP SCM™.
b) Administration of sourcing priorities and quota arrangements.	Rules for sourcing decisions should be defined and documented.	Not in scope of SAP SCM™.
c) Coordination of safety stock policies; visualization of interdependencies between safety stocks for different components, products, and locations.	It is necessary to decide to what extent safety stocks in warehouse A can be used when there is an urgent demand in warehouse B, and vice versa. Advantages of lower safety stocks have to be compared with disadvantages of stock transfers between warehouses.	Cf. Section 4.4.4.B.
d) Simulation models.	May be helpful for analyzing safety stock policies; cf. item c) above.	Cf. Section 4.2.

2.3.4.3 Operational Procurement Planning

Desirable Features	Comments	Coverage by SAP SCM™
a) Call for tenders on B2B platforms; organization of (reverse) auctions.	For components with uncritical properties it is also important in supply chains to select the best offers.	Not in scope of SAP SCM™.
b) Pegging.	Assignment of customer orders to production orders, procurement orders, transportation orders, and other sources.	Cf. Section 4.2.4.A.

Desirable Features	Comments	Coverage by SAP SCM™
c) Collection of tracking data, considering transports on their way for planning, scheduling, and accounting.	Real-time data about the location of materials is important for short-term planning and scheduling.	No direct link from tracking data outside the boundary of the corporate group to planning.

2.3.5 *Production Planning*

2.3.5.1 Strategic Production planning

Desirable Features	Comments	Coverage by SAP SCM™
a) Coordination of the production capacities between the partners in the supply chain, especially between factories that can produce identical items and thus support each other in the case of bottlenecks.	In some cases the coordination is organized as an internal market on which the plants offer their products.	Not in scope of SAP SCM™.
b) Considering subcontracting and outsourcing as way out of capacity bottlenecks.	If the software does not support such decisions directly, the user might include the additional transports as set-up operations/costs.	Cf. Section 4.2.4.G for operative subcontracting.
c) Manifold simulations to evaluate alternative actions.	Simulations may support the choice of the alternatives; cf. items a) and b) above.	Cf. Section 4.2.

2.3.5.2 Tactical Production Planning

Desirable Features	Comments	Coverage by SAP SCM™
a) Cross-plant planning.	In supply chains with tight supplier-customer relations it is worthwhile to plan and schedule the capacities of plants in a similar way to those of machines and workplaces in an intra-plant MRP system. Transportation times between the plants would then correspond to set-up times in an MRP system.	Cf. Section 4.2.2.
b) Rules for access to safety stocks and for stock transfer of semi-finished products when shortages occur.	Agreements between the partners in a supply chain should include such rules to avoid complicated negotiations in critical situations.	Available within company. Not available between different companies; cf. Section 4.4.4.
c) Coordinated production and distribution planning.	Especially in global supply chains, if products have a short life cycle and distinct seasonal peaks, it is challenging to take into account the restrictions (time and quantity) for the downstream distribution. In this case the production plan is derived from the distribution plan. The theoretical optimum would be achieved by simultaneous planning, but in practice this is too complex in many cases.	Cf. Section 4.2.2.
d) Flexible definition of resources, e.g., minimal and maximal load, calendar-dependent capacities.	Typical examples for calendar-dependent capacities are reduced openings because of vacation closedowns or scheduled maintenance tasks.	Can be defined in master data; cf. Section 4.7.3.

Desirable Features	Comments	Coverage by SAP SCM™
e) Calculations of additional costs for a short-term enlargement of capacities, e.g., by running overtime.	Easing of a bottleneck in one factory may result in benefits for several partners. Therefore the contribution of each of the partners should be calculated with methods that are standardized in the supply chain to avoid recurrent negotiations.	Cf. Section 4.2.2.E.
f) Planning without final assembly.	Often the final assembly is not initiated until after an order comes in from the customer. However, "virtual intermediate products" may be produced and stored without order because they are used in several final products and will reduce the throughput-time.	Cf. Section 4.2.1.G.
g) Subassembly planning.	The assembly of the components is planned according to consumption. When customers' orders arrive, the components are "consumed." In contrast to item f), one does not plan production of the components only, but also the assembly.	Cf. Section 4.2.1.G.
h) Definition and application of different priority rules for Capable-to-Match (CTM).	Several production orders may compete for scarce resources. When a CTM analysis is applied, priority rules are necessary to determine realistic delivery dates.	Cf. Section 4.2.2.F.
i) Manifold simulations to evaluate alternative decisions.	Simulation may support the decisions mentioned in items b), c), and h) above.	Cf. Section 4.2.

2.3.5.3 Operational Production Planning and Scheduling

Desirable Features	Comments	Coverage by SAP SCM™
a) Production scheduling agreements.	These agreements are very important in industries where set-up times are long and set-up costs high. If the production plans are not harmonized and JIT delivery is agreed on, it may happen that the supplier has to produce a big lot when it does not fit into the set-up cycle because the customer urgently needs the component for its own production process.	Exchange regarding net requirements as a result of MRP; cf. Sections 4.2.3.C, 4.2.3.D, 4.3.1.B, and 4.3.1.C.
b) Heuristics for lot sizing and for priority rules, considering bottlenecks and impact on suppliers and customers.	In tactical production planning lot sizes are determined on a rough basis. These lot sizes may be modified in detailed planning and scheduling to take the actual situation in the production environment into account.	Lot sizes are regarded as master data; cf. Section 4.7.3. Heuristics for determining lot sizes are also available.
c) Alert if the synchronization of processes is violated.	Alerts when production and distribution processes which originally had been planned collaboratively are no more synchronized because of rescheduling measures, disturbances, or interruptions; the alerts have to be sent to all departments involved, e.g., by an inter-company workflow.	Cf. Section 4.6.2.

Desirable Features	Comments	Coverage by SAP SCM™
d) Considering aggregated scrap.	The scrap accrued within the supply chain must be considered in production and distribution planning.	Can be defined in master data; cf. Section 4.7.3.
e) Backorder processing, especially administration of priorities for customers and orders.	Determine most urgent backorders for earlier processing. Backorders must be considered in ATP and CTM.	Cf. Sections 4.2.4.C and 4.2.5.G.
f) Net change planning.	Because of the tight coupling of the procurement, production, and distribution plans within the supply chain, determining a new plan after each modification typically is uneconomical. Therefore methods of net change planning and scheduling, regarding only the modified data, are important so that provisional results can be obtained. However, certain (mostly temporal) events trigger the total update of all plans in a new planning run.	SAP systems apply net change planning in most cases.

2.3.6 Distribution Planning

2.3.6.1 Strategic Distribution Planning

Desirable Features	Comments	Coverage by SAP SCM™
a) Definition of rules for backorder processing.	Backorders may result from disturbances on the sell-side (e.g., because an urgent order has to be served), from production (e.g., because of interruption of a production line or unexpected scrap), or from the buy-side (e.g., delay in delivery). Distribution strategies should be defined to allow rush transports in case of urgent delivery needs to partially compensate for the delays that resulted in earlier stages.	SAP SCM™ allows to model the rules in Backorder Processing; cf. Section 4.2.5.G.
b) Make-or-buy decisions for transportation services.	Use of own truck fleet vs. contracting professional shippers.	Not in scope of SAP SCM™.
c) Degree in which value-added services of service providers are accepted.	Decisions about buying services offered as "Fourth-Party Logistics."	Not in scope of SAP SCM™.
d) Implementation of track-and-tracing functionalities.	May imply use of RFID instead of barcode.	Not in scope of SAP SCM™.

2.3.6.2 Tactical Distribution Planning

Desirable Features	Comments	Coverage by SAP SCM™
a) Package planning coordinated with clients and suppliers.	Package planning has to consider, e.g., the transport equipment. Client-specific packages can be necessary in addition to the standard package. Package planning may be integrated with product design and means of transport decisions, e.g., adaptation of boxes to vials and tubes in the cosmetics industry, bicycles without overhanging parts so that the storage space in the means of transportation is well utilized.	Not in scope of SAP SCM™.
b) Administration of delivery windows.	Delivery windows at the customer's site are as important as pick-up windows at the supplier's site. Time slots may vary, e.g., during the holiday season.	Cf. Section 4.2.6.A.
c) Supply distribution; push without demand.	Sometimes a factory has the power to push products to the point of sale even if there is no immediate demand.	Only in the internal supply network; cf. Section 4.2.2.F.
d) Procedures for deployment; agreement of deployment rules.	Deployment becomes relevant if demand exceeds production capacity or scarce stocks have to be allocated. In this case different deployment procedures and priority rules must be applied, e.g., agreed quotas, precedence for filling safety stocks, allocation proportional to past deployment, and pro rata fulfillment of open orders. In refined versions transports and their costs will also be considered, so that (e.g.) a full shipload is accomplished.	Cf. Sections 4.2.2.I and 4.4.4.A.

Desirable Features		Comments	Coverage by SAP SCM™
e)	Transport ATP and CTP.	By analogy with planning of delivery dates for production there is also a need to organize delivery dates for distribution. In developing distribution plans the availability of means of transport or the time and costs for delivery from other warehouses (e.g., for important spare parts) have to be considered.	Cf. Section 4.4.4.B.
f)	Presentation of alternatives and/or substitute solutions.	Examples are cargo flights when waterways are temporarily impassable. Usage of faster means of transport in case of delays or when delivery of spare parts is urgent.	Cf. Sections 4.2.2.E and 4.4.4.A.
g)	Determination of transport lot sizes.	Transport lot sizes can strongly influence the production and delivery planning of partners when goods have high carriage costs.	Not in scope of SAP SCM™.
h)	Relocation of stocks.	In some cases it may be necessary to modify earlier distribution decisions and to change the location of certain stocks to fill urgent orders from customers or to provide sufficient safety stocks.	Cf. Section 4.4.4.B.
i)	Coordination of intermediaries.	Logistics service providers are often employed for some or all distribution tasks. These companies often belong to the class of Small and Medium Enterprises (SME), for which it may be difficult to implement sophisticated IT systems for seamless collaboration with their supply chain partners.	Cf. Section 4.6.1.
j)	Manifold simulations for evaluation of alternative procedures.	Simulations can be helpful, e.g., for items f) and h) above.	Cf. Section 4.2.

2.3.6.3 Operational Distribution Planning and Scheduling

Desirable Features	Comments	Coverage by SAP SCM™
a) Shelf-life monitoring.	The supplier may be responsible for shelf-life management, including the placement of articles in the shelves and observing dates of expiry, notably for food, cosmetics, and pharmaceuticals. Destruction of expired products can result in urgent distribution activities. In VMI relationships the supplier may have to consider POS data for forecasting distribution needs.	Only within company; cf. Section 4.2.4.E.
b) Consideration of tracking dates and of stocks on their way in accounting and planning.	At accounting dates (e.g., for quarterly reporting) stocks on their way have to be documented and valued. Rules are needed on whether stocks are to be committed as assets of the supplier or of the customer when they are en route.	Stocks in transit are considered in the planning modules. Accounting is not in the scope of SAP SCM™.
c) Consideration of storage and handling restrictions.	Examples are special procedures for transporting dangerous goods or special cranes in harbors.	With limitations, cf. Sections 4.2.2 and 4.2.4.F.
d) Transport leitstand.	Similar to control units ("leitstands") employed in production scheduling, transport leitstands may visualize the use of transportation resources and the dependencies between consecutive transport activities.	Cf. Sections 4.2.2.C and 4.2.6.A.
e) Use of previously agreed deployment rules.	Rules defined at the tactical level are applied in the case of shortages.	Cf. Sections 4.2.2.I and 4.4.4.A.

Desirable Features	Comments	Coverage by SAP SCM™
f) Vehicle scheduling regarding incompatibilities.	For example, security regulations dictate that the transport of hydrogen and oxygen tanks on the same vehicle must be avoided.	Cf. Section 4.2.6.A.
g) Transport load builder.	Several strategies should be represented in the software, e.g., loading of trucks with the same goods independently of the target location or loading of trucks that drive to one target location with goods of different types and with different delivery dates.	Cf. Section 4.2.2.J.

2.3.7 Return and After-Sales Processes

Desirable Features	Comments	Coverage by SAP SCM™
a) Especially in make-to-order production it is very important for the service-person to know which components have been used in producing a product which is out of order.	Detailed documentation of product properties in PDM systems is important. The service-person should have easy access to this information. Often the after-sales service is provided by a different company; in this case sharing the data is an important issue for efficient after-sales services.	Not in scope of SAP SCM™.
b) Customer care should be supported beyond the purchasing act.	For products with a typical usage time it is important to contact the customer in time to influence his replacement purchase. A close coordination with CRM systems is necessary.	Not in scope of SAP SCM™.

Desirable Features	Comments	Coverage by SAP SCM™
c) Recycling can be supported by design processes and detailed documentation of product properties in PDM systems.	The limited availability of natural resources makes recycling of components at the end of the life cycle of the associated product a high priority. This information should be shared with companies that are active in the recycling process.	Not in scope of SAP SCM™.
d) Returning handling units.	Special containers, bins, pallets, etc. may have to be returned to the supplier and a "Reverse Supply Chain" has to be organized using similar planning and scheduling methods as in the "Forward Supply Chain."	Not in scope of SAP SCM™.

2.3.8 Controlling and Support Processes

2.3.8.1 Supply Chain Event Management (SCEM)

Desirable Features	Comments	Coverage by SAP SCM™
a) Detection of events.	The more details IT systems are recognizing, the higher the potential for defining and detecting events that may be relevant internally and for supply chain partners.	Cf. Section 4.6.1.
b) Rule-based filtering of detected events using a flexible, parameter-controlled definition of what should be considered a relevant exception.	Filtering mechanisms are highly relevant to avoid information overloads.	Cf. Section 4.6.1.

Desirable Features	Comments	Coverage by SAP SCM™
c) Assignments of events/deviations to institutions and bearers of roles, who have to be informed. Information of these addressees inside and outside the firm (workflow management).	Events that are relevant internally may not be of interest for other partners in the supply chain. Different filtering parameters can be applied for different partners in the supply chain.	Cf. Section 4.6.1.
d) Simulation of the impact of events on the buy-side (upstream simulation) and on the sell-side (downstream simulation) (diagnosis).	Some situations that should be simulated are: upstream, the loading/overloading of warehouses if the suppliers cannot stop their production processes while there are distribution problems; downstream, the impairment of customers' readiness for delivery if safety stocks are violated.	Not in scope of SAP SCM™.
e) Selection of standardized remedial actions using priority rules (proposal of therapy).	Not all possible actions can be proposed by the IT system, but only those that are predictable or standardized.	Not in scope of SAP SCM™.
f) Simulation of impact of remedial actions on the supply chain as a whole (forecast of effects of therapy).	*Example: Parts reserved for customers B and C could be sent to the prioritized customer A because of an accident during transport to A. The simulation tries to determine when the production at plants B and C may have to stop because of missing materials. The impact on B's and C's customers may also be considered. What would be the effect if A were served later and the orders from B and C were fulfilled in time?*	Not in scope of SAP SCM™.

2.3.8.2 Management Information/Performance Management

Desirable Features	Comments	Coverage by SAP SCM™
a) Visualization of actual states by activating nodes and arcs.	This feature allows the selection of detailed data without showing the same level of detail in other, currently less relevant areas. *Examples are capacity usage, frequency of disturbances, or delays.*	Cf. Section 4.6.2.
b) Tracing procurement processes.	Upstream tracing over several partners in the supply chain is especially important in industries where certain problems have to be detected immediately (e.g., contamination in the food industry or mechanical ruptures in the construction industry).	SAP Event Manager™ (cf. Section 4.6.1) might cover this to some extent.
c) Methods for evaluating customers.	Methods to calculate the customer lifecycle values are needed to define priorities within deployment.	Not in scope of SAP SCM™.
d) Generator for performance measurement systems (e.g., DuPont scheme, Value driver trees, Balanced Scorecards).	Flexible generation of reports on KPIs should be provided.	Not in scope of SAP SCM™.
e) Adaptation of the metrics provided in the SCOR® model to a KPI system that is suitable for the supply chain.	For the SCOR® model and the metrics proposed in it cf. Section 2.2.2.	Not in scope of SAP SCM™, but of SAP BI™.
f) Delivery of business content, e.g., average values or benchmark data for certain industries.	The use of such data, provided by associations like the SCC, consultancies, or the producer of SCM software can contribute to continuous improvement of the supply chain.	Not in scope of SAP SCM™, but of SAP BI™.

Desirable Features	Comments	Coverage by SAP SCM™
g) Exchange of indicators with the supply chain partners in a standardized format.	*Examples: By using XML or the Extensible Business Reporting Language XBRL.*	Not in scope of SAP SCM™.
h) Balanced Scorecard for SCM. Coordination of the SCM Scorecard with other Scorecards within the firm and with those of supply chain partners.	If the goals and the indicators in the Balanced Scorecard of one firm are coordinated with those in the Balanced Scorecards of the partners a kind of competition within the supply chain may result. This is important when suppliers of similar products, components, or raw materials must be compared. The Scorecards of different partners in the supply chain may look quite different owing to industry specifics. An SCM system should provide support in aggregating and coordinating the different Scorecards. The values can be compared over time and, if relevant benchmarking data for similar supply chains is available, also with this data.	Not in scope of SAP SCM™.

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